



# Earth Science and Astrobiology from the Moon or near Moon

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teams

# Issues

What is the science and why is it significant?

Science concept development

Technology concept development

Related lunar studies.

Where next?

# Planet finder goals and priorities

- 1) To find the variety of planetary system structures?
- 2) To find a planet of  $\sim$  Earth mass, whose surface can be observed, despite atmosphere, clouds and haze.
- 3) To discover whether a planet has liquid water available at its surface.
- 4) To discover whether the atmosphere shows signs of having been modified by life.  
(as if we understood how & why it was originally!)

# What is the science and why is it significant?

1. How can we assess the environment of an Earth-like planet from studying it as a point source?
2. How do we validate extracting 2D information from a "point" planet. (though rotating and with seasons)?
3. Why does astrobiology want to? (Life!)
4. The TPF problem - Science is neither planetary science nor astrophysics yet they take up (*control*) most science missions.
5. Unwillingness to believe the new technology.
6. Earth Science aspects have political overtones.

# Information potentially available

- 1) Spectral characteristics.
- 2) Spectro-polarization characteristics.
- 3) Time variation of these.

But even if one could obtain all of this data, how could one validate it?

Answer:

The best data could be obtained for Earth.

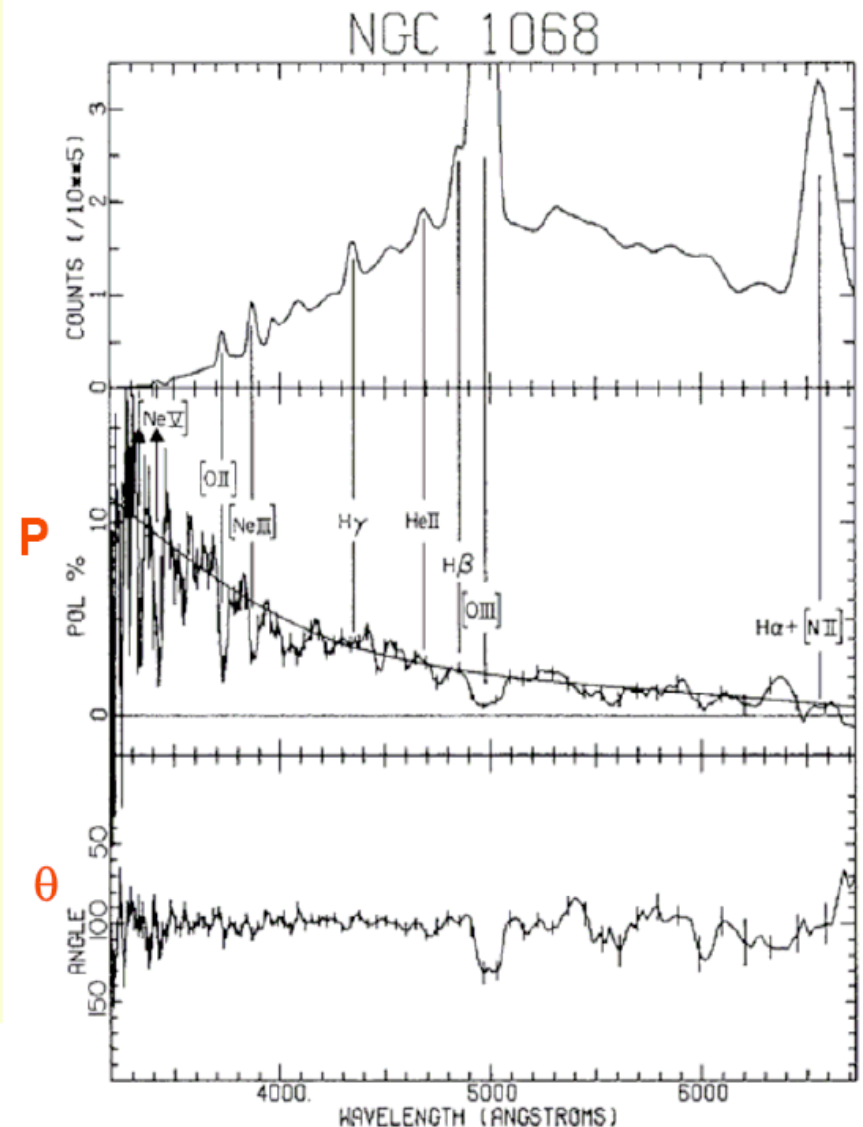
- a) Whole Earth pictures can be combined with local information of what processes they represent.
- b) Simultaneous spectro-polarimetry demonstrates the effect of the processes in creating analyzable data.

# Spectropolarimetry discriminates with $P\%$ & $\theta$

Spectropolarimetry  
discovered vertical  
structure in a  
single pixel object.  
 $H\beta$  and  $[OIII]$  arise in  
different layers.

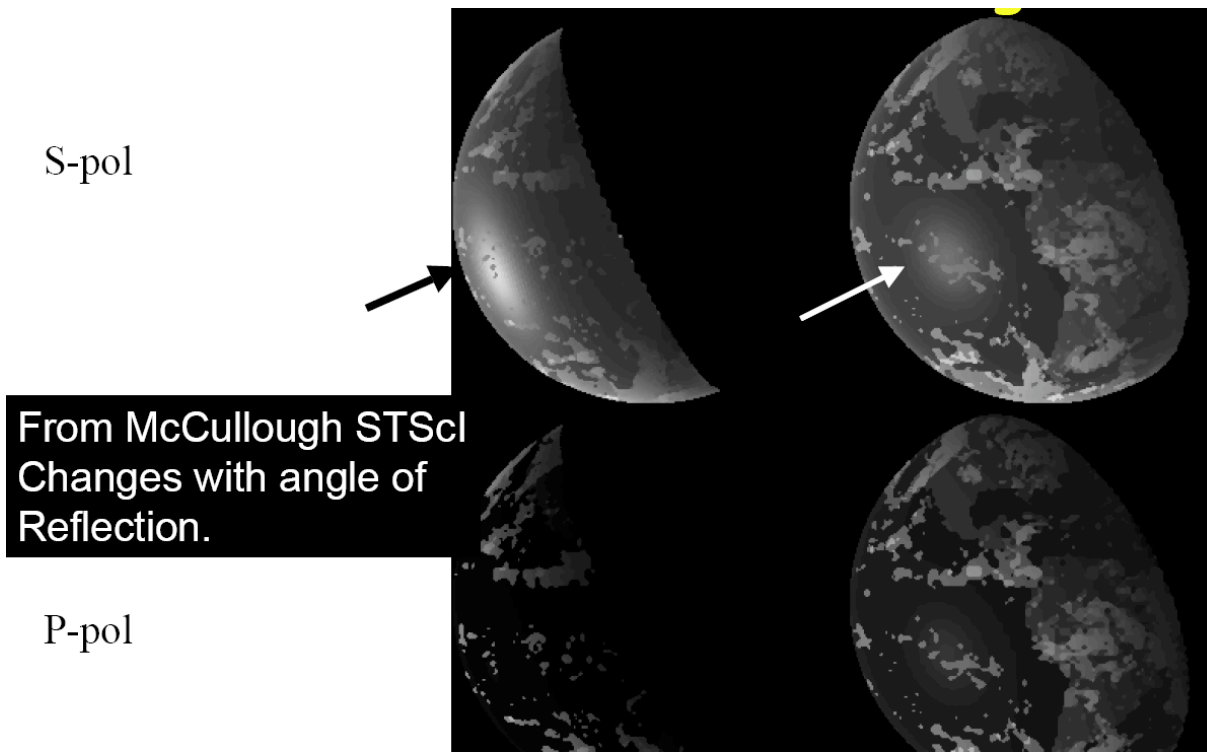
Implication for planets  
Polarizing processes with  
different spectra,  $P, \theta$   
can be separated

Angel, Stockman, Woolf,  
Beavers & Martin Ap.J.1976



# Earth Polarization

- Clouds - linear, varies with sun angle
- Oceans - linear, varies with sun angle
- Vegetation - Circular! (but weak)



## From Mike Zugger presentation at VPL Progress To Date

1. Survey and study of available codes settled on Oceans coupled with 6SV;
2. Computer stuff:
  - a. Accounts set up on 3 GHz 64-bit Linux,
  - b. Access to MODTRAN4 and quick tutorial provided;
  - c. IDL software (to run Williams model) purchased and installed,
  - d. 6SV code downloaded, installed, batch files written to call, up and running;
  - e. Williams Oceans model installed, files transferred, up and running;
3. Initial literature search has been completed;
4. Collaboration established with Oceans and 6SV developers;
5. Preliminary models of Mars, Venus in progress, water Earth complete;
6. Development of mods to both programs initiated.



# Science Conclusion

From time variation associated with:

planet rotation - may see continents/oceans

Motion around star - may see seasonal effects

Linear polarization - may demonstrate presence of water

Circular polarization - may show land vegetation.

The test is can we do it with Earth?



If we do it with Earth we **also** get a time baseline on Whole Earth change (Earth Science)

# Technology Choices

~ 400,000km from Earth limits loss around limb to  $2^\circ$ . Non Geostationary orbit wanted for Earth survey.

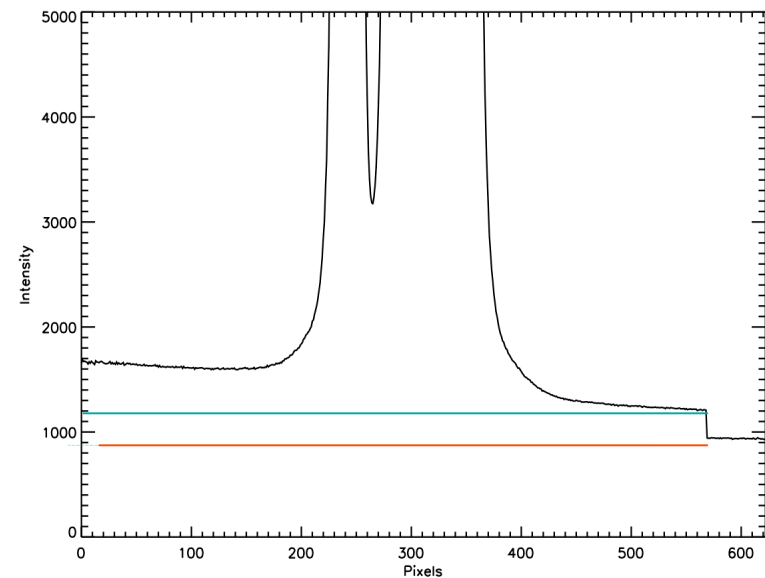
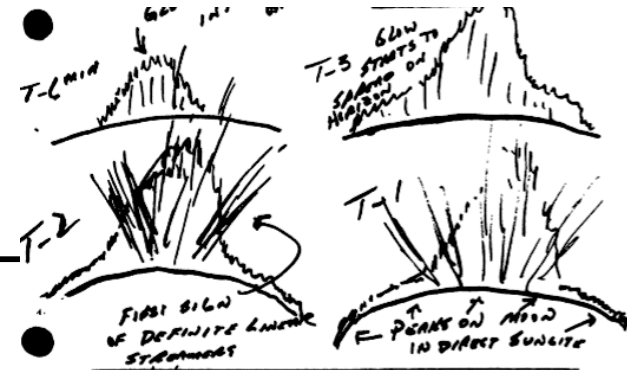
On Moon - human placement suffers from Earth not always visible & human related dust. Instrument rotation for polarization observations needed.

Rotational stabilized image @ L1 or L4 allows near complete view & polarization calibration is automatic. Requires gas jet torquing - lifetime limited.

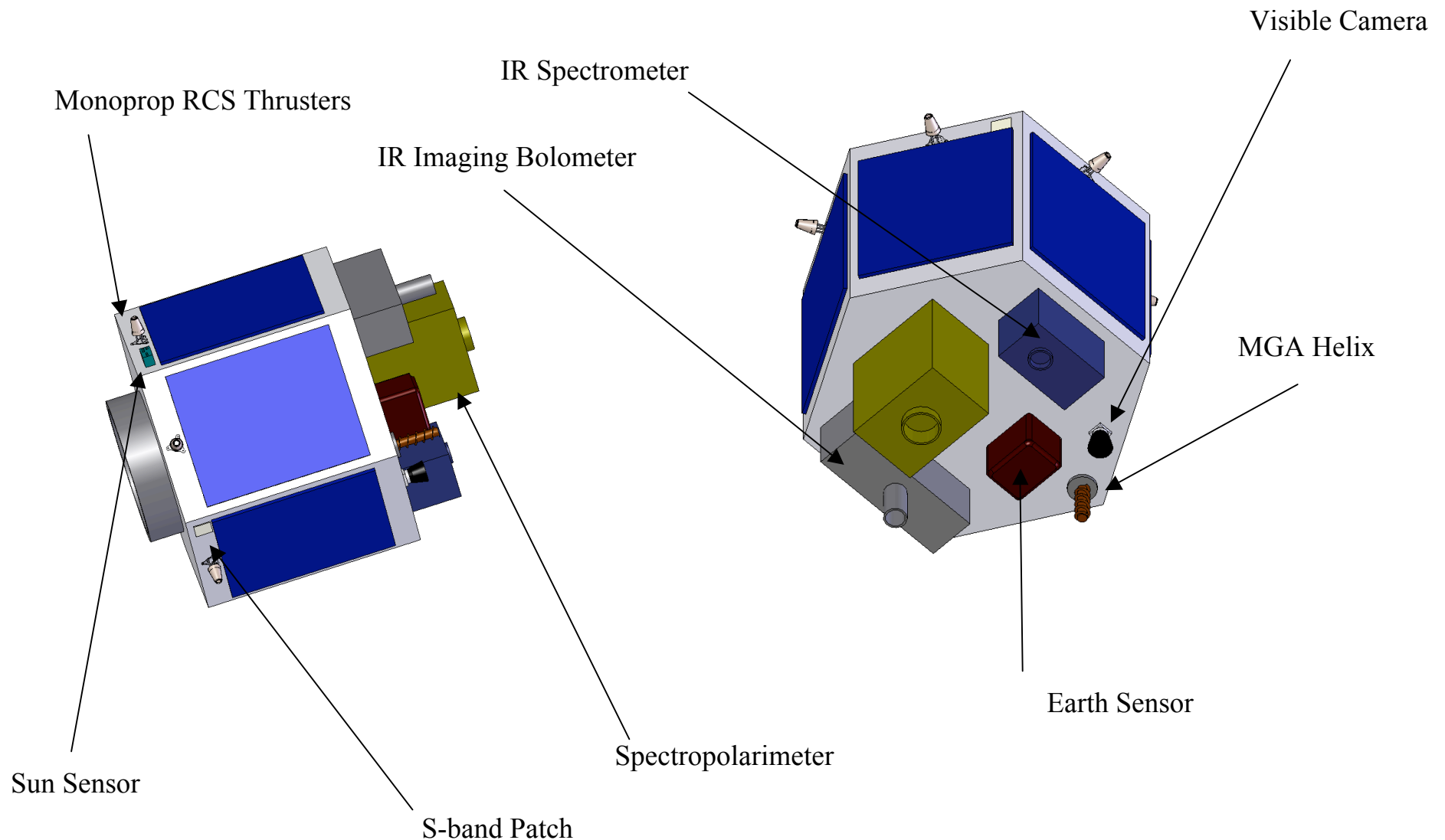
# Search for lunar dust

## Amanda Ford

(independently supported through NAI)



# SMEX Deployed Configuration

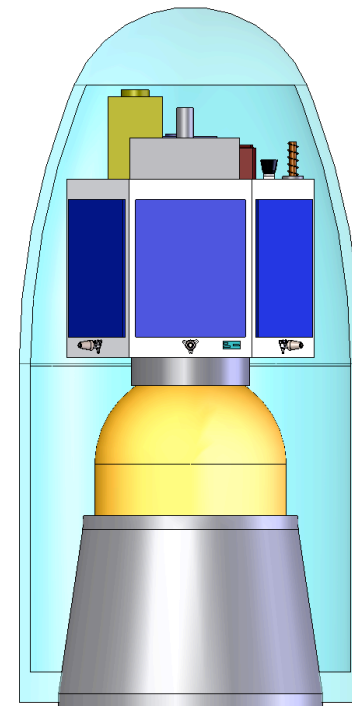
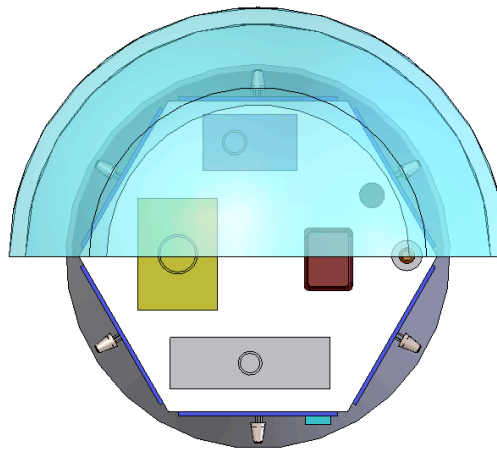
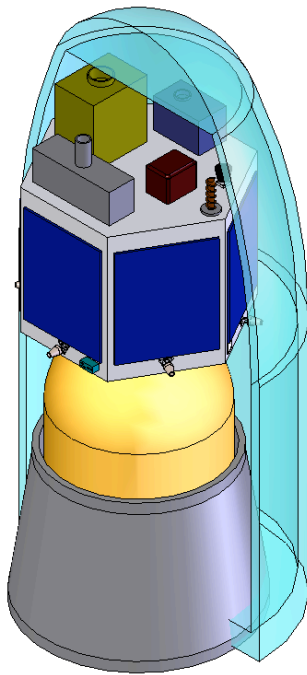


From Aerospace Corporation

# Stowed Configuration

Pegasus XL Faring with Star27 Motor

May need to recess spectropolarimeter slightly into bus for clearance



# Where Next?

- Zuger's funds are spent out.
- Aerospace Corp. is continuing to examine the Small Explorer (which they call Blue Marble)
- Enough funds still available to have a small conference.
- How can we explain task importance to AMES and Goddard (they claim they couldn't explain it to HQ)?
- Conference only worthwhile with a receptive audience which suggests after January 2009.